in which all the functions of the protoplasm are quiescent, but from which they revive when again placed in conditions suitable for germination. The immunity from injury appears to depend on the protoplasm of the seed passing into a completely inert state, in which it is incapable of either respiring or assimilating, before exposure to the unfavourable conditions. The period of suspended animation may extend over an indefinite time, probably through a long series of years, and the seeds may during this period be subjected to very low temperatures without destroying their vitality. Those above mentioned were exposed, in a refrigerator, as many as 118 times in succession, to a sudden cooling to temperatures varying between - 30° and - 53° C., without injurious effects. On the other hand, seeds of the sensitive plant and of *Lobelia Erinus* succumbed, for the most part, to similar treatment. These statements have an important bearing on the question of the retention of their vitality by buried seeds.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mrs. Herman Schlesenger; a Rhesus Monkey (*Macacus rhesus*) from India, presented by Miss Folhurst; a Macaque Monkey (*Macacus cynomolgus*) from India, three Slow Lorises (*Nycticebus tardigradus*) from Sumatra, presented by Mr. Stanley S. Flower; a Geoffroy's Marmoset (*Midos geoffroii*) from Panama, presented by Miss Mina Sangiorgi; a Green Monkey (*Cercopithecus callitrichus*) from West Africa, presented by Mdlle. Eugénie Grobel; a Barbary Ape (*Macacus inuus*) from North Africa, presented by Mr. Edwin Fletcher; two Crested Porcupines (*Hystrix cristata*), two Cape Zorillas (*Ictonyx zorilla*) from South Africa, presented by Mr. J. E. Matcham: a Ducorp's Cockatoo (*Cocatua ducorpsi*) from the Solomon Islands, presented by Mrs. Dexter; a Nightjar (*Caprimulgus europæus*), European, presented by Mr. T. West Carnie; two Robben Island Snakes (*Coronella phocarum*) from South Africa, presented by Mr. Barry McMillam; a ——— Chameleon (*Chamæleon basiliscus*) from Egypt, presented by Mr. J. Buchanan; a Brown Capuchin (*Cebus fatuellus*) from Guiana, a Black-backed Jackal (*Canis mesomelas*) from South Africa, six Ring-tailed Coatis (*Nasua rufa*) from South America, deposited; a Red River Hog (*Potamochœrus penicillatus*) from West Africa, a Sooty Phalanger (*Phalangista fuliginosa*) from Australia; a De Filippi's Meadow Starling (*Sturnella defilippi*) from La Plata, purchased; two Mandarin Ducks (*Æx galericulata*), seven Summer Ducks (*Æx sponsa*), three Chilian Pintails (*Dafila spinicauda*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE ROTATION OF VENUS.—Notwithstanding the persistence with which the planet Venus has been telescopically observed, the period of rotation is still undetermined with anything like certainty. Schröter believed the time of rotation to be 23h. 21m.; and this period, or thereabouts, was pretty generally adopted until the announcement by Schiaparelli, in 1890, that the time of rotation was probably equal to that of the planet's revolution round the sun, that is, about 225 days. This conclusion was based on the rigidity of the markings at different hours of the day and for weeks together. Observations by M. Perrotin and Dr. Terby tend to strengthen the conclusion arrived at by Schiaparelli. On the other hand, M. Niesten observed the planet between 1881 and 1890, and found that a period of 23 hours satisfied his observations; while M. Trouvelot, from nearly twenty years' work, concluded that the rotation period was about 24 hours. In this divided state of opinion, therefore, it is evident that much remains to be done before any satisfactory conclusion can be drawn.

During the present year, Mr. Brenner, of the Manora Observatory, has observed the planet as frequently as possible since April 17 (*Ast. Nach.* 3300). His first observations of a bright and a dark spot near the north pole led him to agree with Schiaparelli, but further observations have changed his opinion, and he now believes the period to be about 24 hours. On July 2 he announced that a marking near the southern cusp had been visible since June 9, but became invisible about 4 p.m. each day, while a well-marked streak appeared about 8 p.m. Other marks also appeared and disappeared in a manner inconsistent with a rotation period of more than 24 hours. One of the most important of the markings, though noted quite independently, appears to be identical with one observed by Mr. Stanley Williams eleven years ago; in a communication to Mr. Brenner, Mr. Williams states: "In 1884 I managed to secure about one hundred sketches of the markings on Venus. These mostly favour a rotation of about 24 hours; but there was one strongly-marked indentation near the southern horn, which remained visible continuously for about a month. It was prolonged on the disc by a narrow and unusually dark and definite streak (for Venus)." Mr. Brenner has since claimed to have proved with certainty that Venus rotates in about 24 hours; some of the markings return regularly at the same hour of the day, and are invisible at other times, when the definition is equally good; and it is even possible to observe the appearance and advancing of the most conspicuous streak.

GEODETICAL OBSERVATIONS.—Dr. Geelmuyden, of Christiania, has recently published the results of a comparison between the astronomical and geodetical determinations made in the course of a triangulation of Norway. The stations selected for observation lie between 59° and 64° lat., and the astronomical work connected with the investigation was conducted under the direction of the late Prof. Fearnley, extending as far back as 1868. The observations refer to measurements made at eleven stations, of which nine have both the azimuth and latitude determined, and two the difference of longitude.

As origin for the geodetical survey, the geographical coordinates of Dragonkollen, a station on the Swedish border, have been chosen, partly because its position is particularly well determined, but principally on the ground that its situation points to the existence of a very small local attraction. Assuming that for this station a vertical line coincides with the normal of Bessel's ellipsoid, Dr. Geelmuyden has computed, with the data already collected in the course of the geodetic survey, the deviations of the plumb-line for the other stations, in which both the azimuth and the latitude have been determined. The results are shown in the following table:—

Station.	Difference of azimuth.	Difference of latitude.	Deviation of vertical.
Jonsknuden	+ 8″·55	- 1″·31	5″·17
Gausta	- 6·23	—	—
Husbergöen	- 0·72	+0·54	0·68
Christiania	- 3·87	+1·79	2·87
Högevarde	- 13·00	—	—
Hostbjörkampen	+ 6·40	+4·68	5·88
Næverfjeld	+ 4·49	+6·62	7·06
Gien	- 10·72	- 2·65	6·20
Graakallen	- 7·71	- 6·98	7·98
Norberghaug	- 6·70	+0·67	3·36

The deviations of the plumb-line here shown, agree on the whole with what might be expected from the conformation of the surface and the contiguity of neighbouring mountains. For example, the westerly deviation of Gien can be explained by the attraction of Dovrefjeld. An exception is, however, met in the case of Norberghaug, where an easterly rather than a westerly deviation would have been expected. A map is attached, in which is shown both the position of the several stations and the direction of the deviation of the plumb-line.

THE INSTITUTION OF MECHANICAL ENGINEERS.

THE annual summer meeting of the Institution of Mechanical Engineers was held in Glasgow last week, under the chairmanship of the President of the Institution, Prof. Alexander F W. Kennedy, F.R.S. A strong local committee had be organised under the chairmanship of Sir Renny Watson, P

Archibald Barr being Secretary, and very complete arrangements had been made for the instruction and entertainment of members taking part in the meeting. In a great engineering centre there can be no lack of objects of interest to afford excursions for a meeting of this Institution, and the organising committee had taken full advantage of the facilities put at their disposal by owners of works who had liberally thrown them open to members.

The meeting commenced on Tuesday, July 30, and was brought to a conclusion on the Friday following. The mornings of the two first days were devoted to the reading of papers, of which the following is a list:—

Hydraulic stoking machinery and labour-saving appliances in modern gas works, by Andrew S. Biggart.

Notes on modern steel-work machinery, by James Riley.

Recent engineering improvements of the Clyde Navigation, by James Deas, Engineer of the Clyde Navigation.

Notes on hydraulic power supply in towns: Glasgow, Manchester, Buenos Ayres, &c., by Edward B. Ellington.

Papers on telemeters and range-finders for naval and other purposes, by Profs. Barr and Stroud, and on the electric lighting of Edinburgh, by Henry R. J. Burstall, were also on the agenda, but had to be adjourned until the next meeting.

On members assembling in the Institute of Fine Arts, they were welcomed by the Lord Provost of Glasgow, Sir James Bell, and the usual formal business having been disposed of, the first paper was taken, namely, that of Mr. Biggart, on gas works machinery. In this the author described an extensive hydraulic plant which has recently been laid down at the Dawsholm Gas Works in Glasgow. The apparatus is designed to supersede hand labour in the charging of retorts, and clearing them of the residual coke when the gas has been abstracted from the fuel. The usual method of performing these operations by hand must be known to most people. The coal having been broken to suitable size by hand, is placed in the retort by means of a long half-round scoop or trough. This is pushed into the retort and then turned over, the coal then being spilled and spread evenly throughout the length of the retort. This is very laborious work, and moreover the smoke and dust accompanying it are very injurious. It is, however, less trying than the discharging of the retorts, an operation which consists of raking out a mass of coke almost at a white heat. It will be easily understood, even by those not personally acquainted with gas works, that labour of this nature does not tend to the advancement of the labourer, for though good wages are paid they are apt to be spent in ways not all that could be desired. The introduction of machinery to supersede this somewhat demoralising work is therefore a distinct boon to the workman as well as the proprietors of gas works, and thus, indirectly, the users of gas; in fact, it is the oft-told tale of intelligent work being required to produce machines which take the place of the unthinking labourer. That is very nearly the whole history of the elevation of the working classes. In the machinery described by Mr. Biggart, and illustrated by wall-cartoons displayed at the meeting, the coal is broken by a machine having rolls with powerful steel claws which draw in the coal and break it to pieces of the required size. The coal is conveyed by means of buckets travelling on chains; these scoop it up and take it to the machine or to the required spot after it is broken. The charging machine consists first of a steel frame mounted on a carriage which runs on rails laid on the platform in front of the battery of retorts. Attached to the frame is a hopper, and from this a given quantity of coal is allowed to fall in front of a "pusher-plate." The function of the latter is to thrust the coal into the retort, the necessary forward motion being obtained by means of a hydraulic ram. A second ram is used to withdraw the pusher. About six or seven pushes are required to place the coal in a retort, the quantity that has to be placed at the far end naturally going in first. The arrangement of the mechanism is such that the coal is practically level in the retort, a fact which the gas manager looks on as important. There are many very ingenious devices incorporated in the design of this machine, which we have described in so elementary a manner, but to make them clear we should require somewhat elaborate illustrations. All charging operations are performed by means of a single lever. Having charged one retort, the machine is run along the lines of rail to the next retort, and so on through the whole range.

Having described the main outline of the charging machine, the action of the drawing machine hardly needs explanation, the two being so like in principle. In both the mechanism for raising the pusher or rake, respectively from the coal or coke so as to clear them, is very ingeniously devised, compared to hand labour. The saving in time and labour is considerable, as the machine will charge forty-eight retorts in an hour under favourable conditions. Not half the number of men are required in the retort-house; and it is said that the saving which this represents, averages about a shilling per ton of coal carbonised. As, roughly, about 8,000,000 tons of coal are annually used for gas-making in this country, it will be seen that the universal use of these machines should lead to a saving of £400,000 every year, to say nothing of relieving the working classes of exhausting and by no means elevating labour. It is, however, worthy of note, as indicative of the spirit of the age, that it was strikes, or the fear of strikes, that led to the more general introduction of these labour-saving appliances.

In the long discussion that followed the reading of the paper, the most notable point was the testimony of experienced persons as to the success of these machines.

Mr. James Riley's paper, on modern steel works machinery, was a valuable contribution to the published knowledge on this subject. Mr. Riley has taken a prominent position in the manufacture of mild steel from the time the material was introduced commercially, and he therefore speaks with authority. He was connected with the now almost classic Landore Works under Sir William Siemens, but it was as head of the Steel Company of Scotland that he made his name most widely known; indeed, there is no one to whom naval architects and ship constructors owe more than to the author of the paper for what has been done in the development of the steel-plate industry. Mr. Riley has recently found a new field for his energies, and it was largely in the description of the plant which he has been fitting up, that his paper dealt.

Some of the most impressive examples of the mechanical engineer's art are to be found in the modern steel works of this country. Massive cogging-mills, which will roll down an ingot of ten tons of steel, almost at a white heat, into slabs; hydraulic shears which crop off the ends of these slabs, cutting through a thickness of 12 inches and a width of 5 feet of glowing steel; the enormously powerful hydraulic forging presses—the casting for the cylinder alone, in an instance mentioned by Mr. Riley, weighing 64 tons; the plate mills, rail mills, hot saws, the live rollers and hydraulic turning gear, which deal with many ton ingots of steel as if they were but playthings; all these form an exemplification of artificial force hardly surpassed. The paper in question gave descriptions in detail of the most recent examples of these machines, which it would be of interest to repeat; but the difficulty of making the forms of construction clear without the diagrams shown on the walls, will compel us again to confine ourselves to mere outline. In a cogging mill described and illustrated, slabs up to 60 inches wide could be produced, and these are rolled on their edges by vertical rolls, the ordinary horizontal rolls being used for rolling on the flat. Ingots and slabs are taken to and from the mill by special carriages actuated by hydraulic rams. Hydraulic slab shears, described in the paper, have a centre cylinder of 31 inches in diameter, and two side ones 22 inches each; the work being held down by hydraulic power whilst being sheared. The accumulator pressure is one ton per square inch. The table has two hydraulic cylinders, by which it is raised or lowered. Steam slab cutting shears and plate mills are also described. The author advocates the use of three-high plate mills in place of the more usual reversing mill. A three-high mill runs continuously, the work being passed forward between the bottom and middle roll, and back between the top and middle roll. The frequent reversing of the engine driving the rolls, thus done away with, is naturally a source of loss. Hydraulic power has also been adopted for working plate shears, the mechanism employed for actuating the blades being of the nature of a toggle arm worked from a crank shaft by levers.

A long discussion followed the reading of this paper, in which the desirability of rolling plates from the ingot, without previous cogging, was considered very fully. In America this practice is largely, indeed all but universally, followed; but the general opinion of the high authorities who spoke, appeared to be that in England, owing to the diversity of sizes of plates required, cogging into slabs was a necessary part of plate rolling. It is possible, however, that by properly apportioning mills to the description of work required, the intermediate process may in time become less universal in this country. That, however, remains to be seen, and one must remember how difficult it is to shake trade customs, however much they may stand in the way of advancement in manufacturing processes.

Mr. Deas' paper on Clyde navigation improvements was another excellent contribution to the proceedings of the Institution, although perhaps rather of the nature of a civil than a mechanical engineering paper. We use the term "civil engineering" in its restricted but more generally accepted sense. The Clyde is probably the most artificial tidal river in the world. What man has done for the Clyde, and what the Clyde has done for Glasgow, every one has heard. Mr. Deas carries the details of the narrative a step further, showing how he built up good and enduring quay walls where the nature of the ground rendered the task one of the greatest difficulty. The most striking feature was the series of hollow concrete cylinders, sunk into the natural sand or gravel to form a foundation for the quay walls. The method of sinking was ingenious, and to those interested in these matters a perusal of the paper will be of great interest, both in regard to this and many other points.

Mr. Ellington's paper was one of great interest, as, indeed, were all the memoirs read at this meeting. The author has taken the foremost position in the introduction of the distribution of hydraulic power from a central station. The first example on a large scale was the installation at Hull, which was laid down in 1877. This was followed, after an interval of seven years, by the London scheme, which has now reached large dimensions, not far from ten million gallons of water being pumped per week at a pressure of 750 lbs. to the square inch; the mains extending over the most important parts of the metropolis. Since then the system has been applied in Liverpool, Melbourne, Birmingham, Sydney, and Antwerp; the latter city using over three million gallons per week. The latest examples are Manchester and Glasgow, where the pressure has been increased to 1120 lbs. to the square inch. It was the Glasgow scheme that Mr. Ellington chiefly described. These works have been carried out under the supervision of Mr. Corbet Woodall, acting for the Corporation. The engine-house is laid out to contain six sets of triple compound engines of 200-horse power each. There are two accumulators having rams 18 inches in diameter, and 23 feet stroke; each is loaded to 127 tons. The capacity is 57,500 gallons per hour at the standard pressure of 1120 lbs. to the square inch. The water supply is taken from the Corporation mains; in London Thames water is used. The mains are 7 inches in diameter, there being gutta-percha packing rings at the joints.

Speaking of the efficiency of the system, the author founded his remarks chiefly on his experience in London, and it was found that the average for ten years was 0·9243. The efficiency is determined by the fraction representing the ratio of the quantity of water registered by consumers' meters to the quantity pumped at the central stations. In Liverpool a still better coefficient is obtained, the efficiency being 0·9555. A Parkinson meter is used by the author; this is very like a gas meter. The Kent positive low-pressure meter is largely used in London.

Perhaps the most interesting part of Mr. Ellington's paper was that in which he compared the cost of hydraulic power supply and electric supply. The results were largely in favour of the water system, and were certainly somewhat surprising to many. In making this comparison data were taken from the records of the London Hydraulic Power Company and of the Westminster Electric Supply Corporation. In making the comparison 1000 gallons of water at 750 lbs. per square inch is taken as equivalent to 6·518 Board of Trade units of electricity. The analysis showed that the station cost of hydraulic power is 5·172*d.* per thousand gallons pumped at a pressure of 750 lbs. per square inch. The corresponding cost of an equivalent amount of electric energy, reduced to the same hydraulic standard, is 9·014*d.* per thousand gallons; on an electrical standard of Board of Trade units of 0·793*d.* and 1·383*d.* for hydraulic and electrical energy respectively. It was a curious coincidence that, in making this comparison, the capital outlay, output, quantity sold, and average price obtained were nearly the same; it was only in cost of production that the divergence was remarkable. A further point that came out in the discussion was that the dividends paid by the two companies respectively were not greatly different. The author could come to no other conclusion on the figures than that, from some cause not hitherto explained, hydraulic power is much less costly to produce than electricity. Prof. Kennedy, who occupied the chair, and who is so largely responsible for the distribution of electrical energy, could find no fault with Mr. Ellington's figures; but we believe the matter is likely to become the subject of further investigation.

We do not propose dealing with the many excursions that were made, and which included visits to a large number of shipyards, engine works, iron and steel works, as well as the large Corporation undertakings, such as the gas and water works, To describe these at all adequately would require a volume rather than an article. It will suffice to say here that these excursions were well attended, and the meeting was highly successful generally.

THE INTERNATIONAL GEOGRAPHICAL CONGRESS.

THE closing meeting of the International Geographical Congress took place on Saturday morning (August 3), and there seemed to be no dissentients from the opinion that in all its departments the Congress has been a great success. In particular, the meeting is to be congratulated on accomplishing much important work, and combining therewith a large amount of entertainment and social intercourse, without unduly taxing the energies of its members. While there was no reason to expect, in a scientific body like the Congress, any serious complication of interests, it is specially satisfactory to recognise the spirit which showed itself in all the sittings from day to day, and found its most definite expression in the graceful and courteous speech in which General Greely seconded the proposal that the Congress accept the invitation of the German delegates to hold the next meeting in Berlin. The Congress has not as yet met in Germany, and it was felt that a large number of members would have great difficulty in attending a meeting at Washington, although a visit to the United States offered many inducements to accept the cordial invitation which came from that country.

At the close of its proceedings the Congress gave deliverance on a number of important questions which we may take as representing the general views of geographical experts on matters of special moment in that branch of science. With regard to Africa it was agreed that it is desirable to bring to the notice of the Geographical Societies interested in Africa the advantages to be gained:—

(1) By the execution of accurate topographical surveys, based on a sufficient triangulation, of the districts in Africa suitable for colonisation by Europeans.

(2) By encouraging travellers to sketch areas rather than mere routes.

(3) By the formation and publication of a list of all the places in unsurveyed Africa, which have been accurately determined by astronomical observations, with explanations of the methods employed.

(4) By the accurate determination of the position of many of the most important places in unsurveyed Africa, for which operation the lines of telegraph already erected, or in course of erection, afford so great facilities.

Resolutions were passed as to the collection and cataloguing of cartographic materials, and urging that all maps should bear the date of their publication, and the report of an influential commission appointed at Berne to consider a proposed map of the world on a scale of 1 : 1,000,000 was adopted in a form embodying a resolution that:—

(1) The Commission has received the Report of the Berne Committee, and feels grateful for the work done by it.

(2) The Commission declares that the production of a map of the earth to be exceedingly desirable.

(3) A scale of 1 : 1,000,000 is recommended as being more especially suited for that purpose.

(4) The Commission recommends that each sheet of the map be bounded by arcs of parallels and of meridians. A poly-conical projection is the only one which is deserving of consideration. Each sheet of the map is to embrace 4 degrees of latitude and 6 degrees of longitude, up to 60 degrees north, and 12 degrees of longitude beyond that parallel.

(5) The Commission recommends unanimously that the meridian of Greenwich and the metre be accepted for this map.

(6) The Commission recommends governments, institutions, and societies, who may publish maps, to acccept the scale recommended.

(7) The Commission lays down its mandate, and recommends